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ABSTRACT

This study investigated the relationship between both age and conservation and education and conservation. The participants were 16 middle-aged adults, 16 institutionalized adults, and 16 noninstitutionalized adults. Each individual was given three conservation of substance problems, three conservation of weight problems, and three conservation of volume problems. Both the judgments and explanations of the judgments were recorded. A 3 (middle-aged, institutionalized elderly, noninstitutionalized elderly) X 2 (sex) X 2 (judgment, explanation) X 3 (substance, weight, volume) analysis of variance revealed a significant main effect for type of response. Judgements were correct significantly more often than were explanations. No other effects were significant. The relationship between education and conservation suggests that the age differences obtained in previous studies may have been a result of differences in the level of education obtained by the various age groups rather than a result of age per se. (Author)

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Conservation Abilities in Middle-Aged and Elderly Adults

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Abstract

The conservation abilities of middle-aged and elderly adults were compared. The design was a 3 (noninstitutionalized middle-aged, noninstitutionalized elderly, and institutionalized elderly) X 2 (male and female) X 3 (substance, weight, and volume conservation) X 2 (judgment and explanation responses) factorial design. The results of both an analysis of variance and correlational analyses indicated that age was not significantly related to conservation performance. Likewise, no significant institutionalization or sex effects were obtained. However, correlational analyses yielded a significant positive relationship between education and conservation.

Key Words

Conservation

Aging

Education

Institutionalization

Conservation Abilities in Middle-Aged and Elderly Adults

Recent research indicates that elderly adults exhibit performance decrements on most Piagetian tasks. For example, such decrements have been found with classification (Annett, 1959; Denney, 1974; Denney & Lennon, 1972), multiple classification (Denney & Cornelius, 1974), egocentrism (Bielby & Papalia, 1974; Comalli, Wapner, & Werner, 1959; Looft & Charles, 1971; Rubin, 1974; Rubin, Attewell, Tierney & Tumolo, 1973), animism (Dennis & Mallinger, 1949), moral reasoning (Bielby & Papalia, 1974), and various formal operational tasks (Clayton, 1972; Tomlinson-Keasey, 1972). However, the results of studies of conservation among elderly individuals have been somewhat more conflicting.

In several cross-sectional studies in which a number of age groups were compared, elderly adults have been found to perform less well on conservation tasks than young and middle-aged adults. Papalia (1972) tested 96 individuals, ranging from childhood through old age, on standard measures of conservation of number, substance, weight, and volume. The mean scores obtained on the latter three tasks were substantially lower for the elderly adults than for either college-aged or middle-aged adults. No age differences were reported on the number conservation task. Significant age effects were also reported in two other studies. Rubin, Attewell, Tierney, and Tumolo (1973) tested individuals in five age groups: early childhood, late childhood, young adulthood, mature adulthood, and elderly adulthood. They reported that the elderly adults performed at a significantly lower level than the young and middle-aged adults on two-dimensional

space, number, substance, weight, and continuous quantity conservation problems. Sanders, Laurendeau, and Bergeron (1966) compared the conservation abilities of young, middle-aged, and elderly adults on a conservation of surfaces test. Participants were classified as exhibiting no conservation, inconsistent conservation, or consistent conservation. A significantly greater number of elderly adults than either young or middle-aged adults were classified as nonconservers, while a significantly greater number of young and middle-aged adults were classified as consistent conservers.

A couple of correlational studies have also been presented as evidence of a decline in performance during old age because of the low conservation performance of the elderly adults tested. Papalia, Salverson, and True (1973) tested a group of 48 noninstitutionalized elderly adults ranging in age from 64 to 85 years. They found significant differences between the number of individuals passing each type of conservation problem. The proportions passing substance, weight, and volume conservation tasks were 66.9%, 43.7%, and 20.9% respectively. Since the tasks traditionally considered to be more difficult were passed less frequently than the easier tasks, the authors concluded that the elderly participants had lost the ability to conserve on the more difficult tasks but had not yet lost the ability to conserve on the easier tasks. However, the correlation between age and performance was not significant, while the correlation between education and performance was significant. Storck, Looft, and Hooper (1972) tested 24 adults ranging in age from 55 to 79 years, on weight and volume conservation tasks. All individuals obtained perfect scores on the weight conservation tasks, but relatively low scores on the

volume conservation task. These authors also concluded that their results were evidence that elderly individuals exhibit performance decrements on more advanced Piagetian tasks. Again, however, no significant correlation between age and performance was obtained on the volume conservation task. The correlation between education and performance on the volume conservation task was also not significant.

The conclusion drawn by Papalia, Salverson, and True (1973) and Storck et al. (1972) was that their results of rather low-level conservation performance by elderly adults supported the notion that there may be a decline in conservation ability in old age. There are at least two problems with this conclusion. First, it was presumably based on the assumption that a group of younger adults would have performed much better on these conservation tasks. However, since no middle-aged control group was included in either of the studies, we do not know that a middle-aged group would have performed any better. Second, even if age differences were clearly demonstrated, they should not be interpreted as indicating the presence of age declines (for a discussion of the problems associated with such an interpretation see Baltes, 1968 or Schaie, 1965). Thus, these last two studies are inconclusive with respect to both age differences and the hypothesized age declines in conservation abilities among adults.

In a third correlational study, a significant inverse relationship was found between age and performance. Papalia, Kennedy, and Sheehan (1973) tested 48 individuals between the ages of 63 and 92 on a conservation of surfaces task. Although an inverse relationship between age and perforamance was reported, a partial correlation between age and performance, with years of education held constant, revealed a nonsignificant

correlation. On the other hand, a partial correlation between performance and education with age held constant resulted in a highly significant correlation betwen the two variables. Thus, the relationship between educational level and performance appeared to be the crucial one rather than the relationship between age and performance.

There is other evidence which indicates that there may be no difference between the conservation abilities of elderly individuals and younger adults. In addition to studies previously discussed in which elderly individuals attained perfect scores on weight conservation (Storck et al., 1972) and on number conservation (Papalia, 1972), there is also evidence that elderly individuals show no decrement in performance on continuous and discontinuous quantity conservation tasks. Rubin (1975) tested grade 5, grade 7, young adult, middle-aged, noninstitutionalized elderly, and institutionalized elderly individuals. He reported that 92% of institutionalized and noninstitutionalized elderly adults reached criterion on a pretest for conservation on continuous and discontinuous quantity. The remaining 8% (4 individuals) received scores closely approaching criterion. Furthermore, Rubin emphasized his inability to locate nonconserving elderly individuals even when testing adults of low educational levels, low socio-economic class, or institutionalized living conditions (Rubin, 1975b).

While the results of the above studies appear to be conflicting with regard to the effect of age on conservation performance, they do indicate that education may be more closely related to conservation performance than age is. In both the Papalia, Salverson, and True (1973) and the Papalia, Kennedy, and Sheehan (1973) studies education was found to be

significantly related to performance when age alone was not. Thus, the main purpose of the present study was to further investigate the relationship of both age and education to conservation during the adult years. In addition, the effects of institutionalization and sex were investigated, since previous research indicates that these variables may also influence performance on conservation tasks.

The results of studies of the effects of institutionalization have been inconclusive. Chap and Sinnott (1975) reported that institutionalized elderly adults performed at a significantly lower level than noninstitutionalized elderly adults on discrete substance, weight, and length conservation tasks. Rubin (1973) reported that institutionalized elderly adults performed at a significantly lower level on space, number, mass, weight, and continuous quantity conservation tasks. However, he subsequently reported finding no differences between these two groups on tests of conservation of continuous and discontinuous quantity (Rubin, 1975).

In the majority of studies in which sex differences have been investigated, no significant differences have been reported (Papalia, 1972; Papalia, Kennedy, & Sheehan, 1973; Rubin, 1975; Rubin et al., 1973; Sanders et al., 1966). Papalia, Salverson, and True (1973), however, reported a significantly higher level of performance by males on a weight conservation task, but no significant differences on mass or volume conservation problems. In another study, Papalia (1972) found that while there were no significant differences between males and females on number, substance, weight, and volume conservation tasks over most ages, elderly female adults in the two oldest groups had higher overall scores than their male counterparts.

In order to examine the effects of age, education, sex, and institutionalization on conservation performance, both male and female middle-aged and elderly (noninstitutionalized and institutionalized) adults were tested on substance, weight, and volume conservation tasks.

Method

Subjects

Participants in the study were 48 adult residents of Lawrence and Topeka, Kansas. There were 16 individuals (8 males and 8 females) in each of the three following groups: noninstitutionalized elderly, institutionalized elderly, and noninstitutionalized middle-aged adults. The noninstitutionalized elderly group ranged in age from 71 to 80 years ($\overline{X}$ = 76.0 years for males, $\overline{X}$ = 76.1 years for females), the institutionalized elderly group ranged in age from 70 to 93 years ($\overline{X}$ = 77.9 years for males, $\overline{X}$ = 84.0 for females), and the middle-aged group ranged in age from 30 to 48 years ($\overline{X}$ = 36.1 years for males, $\overline{X}$ = 40.1 years for females). The mean number of years of education was 10.5 years for noninstitutionalized elderly males, 11.6 years for noninstitutionalized elderly females, 12.2 years for institutionalized elderly males, 11.4 years for institutionalized elderly females, 10.1 years for middle-aged males, and 11.5 years for middle-aged females.

Participants in the noninstituionalized elderly group were individuals living in their own homes whose names were obtained from the state population schedule for Lawrence. They were contacted both by mail and by telephone to arrange for their participation in the study. Individuals in the institutionalized elderly group were residents of two rest homes

in Lawrence. Participants in the middle-aged group were obtained from door-to-door canvassing in Lawrence and Topeka. An attempt was made to match the middle-aged and the noninstitutionalized elderly groups with respect to socio-economic status.

Procedure

The conservation test consisted of three subtests: one for conservation of substance, one for conservation of weight, and one for conservation of volume. Three conservation problems made up each subtest making a total of nine tasks. The materials used were two ball-shaped portions of clay for the substance conservation tasks, two ball-shaped portions of clay and a balance for the weight conservation tasks, and two round balls of putty which were placed in two identical beakers of water for the volume conservation tasks.

Each person was tested individually in his or her own home or room in the institution by a 20-year-old female. Each individual was seated at a table with the experimenter and was told that he or she was going to do some tasks with the experimenter. At the beginning of each problem the two stimuli were both perceptually and quantitatively equal; that is, the two ball-shaped portions of clay were equally formed for the substance conservation problems, the two clay balls were equally formed and weighed on the balance to show their equality for the weight conservation problems, and the two ball-shaped portions of putty were equally formed and placed in the beakers of water causing the water levels to rise equal amounts for the volume conservation problems. Each individual was then asked if the two stimuli had the same amount of the relevant attribute (substance, weight, or volume). If necessary, the stimuli were altered until the

subject agreed that they were equal. Then the experimenter rearranged or altered the form of one of the objects and again asked the participant if the two stimuli had the same or a different amount of the relevant attribute and why he or she thought so. The questions were as follows:

1. Do these two objects have the same amount of clay or does one have more?
2. If I place these two objects on the balance will they both weigh the same or will one weigh more?
3. If I place these two objects in these two beakers of water, will they both make the water levels rise the same or will one make it rise more?

After each of the trials the two stimuli were returned to their original state. The exact stimulus rearrangements used for the test were as follows:

Substance 1 One ball was formed into a sausage while the other remained unchanged.

2 One ball was formed into a pancake while the other remained unchanged.

3 A small amount of clay was subtracted from one ball while the other remained unchanged.

Weight 1 One ball was formed into a snake while the other remained unchanged.

2 One ball was formed into a cube while the other remained unchanged.

3 A small amount of clay was added to one ball while the other remained unchanged.

Volume 1 One ball was formed into a cylinder while the other remained unchanged.

2 One ball was formed into a log while the other remained unchanged.

3 A small amount of clay was subtracted from one of the balls while the other remained unchanged.

The experimenter obtained two measures of conservation which were scored independently. The first was based on the participant's ability to judge the equality of the two objects after one of them had been changed and the second measure was based on the experimenter's rating of the participant's response to the question, "Why do you think so?" An explanation was rated as correct if it referred to the former equality of the stimuli, compensation, addition/subtraction, reversibility, or the irrelevancy of the change. In each case a correct response was given a score of 1 and an incorrect response was given a score of 0. Each individual therefore obtained a score between 0 and 9 for judgments and a score between 0 and 9 for explanations. Both judgment and explanation criteria were employed so the results would be as general as possible (for a discussion of the issue of conservation criteria see Brainerd, 1974; Gruen, 1966; Reese & Schack, 1974).

Results

To determine the reliability of the ratings of the explanations, a random sample of 48 explanations was judged independently by a second rater. The inter-rater reliability calculated using Scott and Wertheimer's (1962) Index of Inter-coder Agreement for Nominal Scale Judgments was .93.

The means and standard deviations of the judgment and explanation scores are presented in Table 1. A 3 (groups--middle-aged, noninstitutionalized elderly, and institutionalized elderly) X 2 (sex) X 2 (type of response--judgment and explanation) X 3 (type of conservation--substance, weight, and volume) analysis of variance was computed on the scores of all participants. This analysis revealed a significant main effect for type of response, F (1, 42) = 19.37, $p < .001$. As has been found in previous research (e.g., Gruen, 1966; Reese & Schack, 1974), judgments were correct significantly more often than explanations. The interaction between type of conservation, type of response, and sex was significant, F (2, 84) = 3.59, $p < .05$. Further analyses revealed that this interaction occurred because males gave significantly more correct judgments on the substance problems than did females. A significant four-way interaction between group, type of conservation, type of response, and sex, F (4, 84) = 3.45, $p < .05$, which was uninterpretable, was also obtained.

Insert Table 1 about here

Pearson Product Moment Correlation coefficients were computed for the middle-aged and elderly groups combined between conservation performance (summed across all three subtests) and age, and between conservation performance and education. A significant positive relationship was obtained between conservation and education, $r = +.33$, $p < .05$, but conservation and age were not significantly related, $r = -.16$.

A regression analysis was also performed on the total conservation scores (summed across all three subtests) for the middle-aged and elderly groups combined, to further investigate the relationship of age, education, and sex with conservation ability. Sex was coded as a binary variable. No significant beta weights were obtained for age, $\beta = .179$, F (2, 45) =

1.63, or sex, $\beta = -.06$, $F\ (3,44) = .22$; however, education was a significant predictor of conservation performance, $\beta = .35$, $F(1,46) = 6.137$, $p < .05$.

Discussion

While the results of both the analysis of variance and the correlational analyses used in the present study show no significant relationship between age and conservation performance, the results of the correlational analyses indicate a positive relationship between education and conservation performance. Thus, the results of this study confirm the findings of both the Papalia, Salverson, and True (1973) and the Papalia, Kennedy, and Sheehan (1973) studies that, among adults, education rather than age is related to conservation performance.

However, there are two studies in which, while age differences were obtained, no significant relationship between education and conservation was obtained (Papalia, 1972 and Rubin et al., 1973). There are at least two reasons why the results of these studies might differ from those obtained in the present study. First, in these two studies the individuals tested ranged from young school children to elderly adults. Thus, children who had only completed six years of school because they were twelve years old, were treated the same as adults who had never attained more than six years of school. It is possible that the lack of comparability among the educational attainments of the children and the adults is responsible for the lack of a relationship between education and conservation. The effects of a sixth-grade education on a child who has not completed his or her education may be different from the effect of a sixth-grade education on an adult who did not progress beyond the sixth grade. Also it seems possible,

even likely, that a sixth-grade education today might be very different from, and therefore have different effects from a sixth-grade education obtained in the days when the adults were educated.

Second, the correlations in the Papalia (1972) and Rubin et al., (1973) studies were calculated across a large number of individuals of varying ages. The significant relationship between education and conservation in the present study was obtained among a group of adults. Likewise, the positive correlations between education and conservation in both the Papalia, Salverson, and True (1973) and the Papalia, Kennedy, and Sheehan (1973) studies were obtained with elderly samples. It may be that significant correlations would have been obtained between education and conservation in both the Papalia (1972) and the Rubin et al., (1973) studies if those correlations were calculated for the adult group separately.

It is unclear why education would have an effect on conservation so many years after one's formal education has been completed. However, in addition to the possibility that education has a direct effect upon conservation performance, there is the possibility that some other factor or factors related to education are responsible for the correlation between education and conservation. For example, it may be that occupation, leisure activities, intelligence, or some other factor which is related to education may have a more direct influence on conservation performance. One might attempt to unravel the effects of all these education-related variables by including them in a regression analysis as independent variables with conservation performance as the dependent variable.

Regardless of why the correlation between education and conservation exists, the finding is interesting because it suggests that the age differences obtained in previous studies may have been a result of differences in the level of education attained by the various age groups rather than a result of age per se. This suggests that the previously obtained age differences were probably a result of cohort effects rather than age effects and illustrates the difficulties associated with interpreting age differences as indicative of age regression. In order to obtain more unequivocal results regarding age and cohort effects, designs such as those suggested by Baltes (1968) and Schaie (1965) which separate the effects of age and cohort should be employed in future studies.

The results of the present study, in conjunction with the results of earlier studies in which no age differences were found in conservation abilities, stand out as different from the results of studies of other Piagetian abilities among the elderly. While rather striking age differences are usually found with other Piagetian tasks, the results with respect to conservation are more equivocal. One possible explanation for this apparent difference may be that conservation abilities are more frequently used among the elderly than are the abilities tested by other Piagetian tasks. Whereas elderly adults may not have to correctly classify things as living or nonliving (animism), or be able to take a perspective other than their own (egocentrism), or correctly classify objects according to abstract criteria (classification), it seems that they would have to perform tasks that require the use of conservation abilities.

For example, many of the things that elderly adults do such as cooking,

doing the laundry, gardening, and shopping, all demand that the elderly person be able to conserve in order to function effectively. The elderly person must realize that 100 pennies are equal to one dollar regardless of how they look, or that 10 pennies are worth 10 cents whether they are spread out over the counter top or piled into one small pile. Likewise, the cook must realize that a cup of sugar is the same amount whether it is in the measuring cup or in a large mixing bowl. Thus, it is being suggested that conservation abilities may not decline with age because elderly individuals are called upon to use conservation abilities during their daily lives while at least some other Piagetian abilities may in fact undergo a decline if they are abilities that are not used during the elderly years. In order to test this hypothesis a variety of Piagetian abilities could be tested in an age-cohort design. Those abilities which are typically used by the elderly would be expected to show cohort effects but no age effects while those abilities which are typically not used by the elderly would be expected to show both age and cohort effects.

Institutionalization was not found to be significantly related to conservation performance in the present study. This finding supports Rubin's (1975) most recent study; however, it is in contradiction with his earlier study (Rubin et al., 1973). Close inspection of the procedures used in these three studies of institutionalization does not yield any apparent explanation for the differences in the results. Differences in the rest home in which the studies were conducted and/or differences in the kind of residents in the rest homes may account for the differences in the results.

Although sex differences have been reported by Papalia (1972) and Papalia, Salverson, and True (1973), the results of the present study are consistent with the majority of studies in which sex differences have been investigated, i.e., no main effect for sex was obtained.

In conclusion, the main finding of the present study is that education, not age per se, is related to conservation ability during the adult years. The importance of this finding is that it emphasizes the fact that age differences should not be interpreted as age changes without using the more appropriate designs which separate age and cohort effects. In addition, the results emphasize, once again, the important relationship between education and cognitive abilities among the elderly. Although it is not currently clear why education seems to be such an important factor in cognition among adults, the results of the present study indicate that research aimed at a better understanding of this relationship needs to be conducted.

Table 1

Means and Standard Deviations of Judgment and Explanation Scores

	Judgment						Explanation					
	Substance		Weight		Volume		Substance		Weight		Volume	
Middle-aged Adults	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Males	3.00	0.00	2.75	0.71	2.88	0.35	3.00	0.00	2.63	0.75	2.75	0.71
Females	2.75	0.71	2.50	0.54	2.38	0.92	2.50	1.07	2.38	0.75	2.38	0.92
Noninstitutionalized Elderly Adults												
Males	2.63	0.75	2.87	0.35	2.50	1.07	2.38	0.06	2.75	0.71	2.50	1.07
Females	2.50	0.93	2.75	0.71	2.75	0.71	2.50	0.93	2.37	1.19	2.37	1.19
Institutionalized Elderly Adults												
Males	2.50	0.08	2.38	0.52	2.38	0.75	1.75	0.89	2.00	0.93	2.25	0.71
Females	2.25	1.04	2.75	0.46	2.75	0.71	2.13	1.13	2.25	0.71	2.38	0.75

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Footnote

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